WHAT MAKES A PROBLEM SUITABLE FOR SIMULATION MODELING AND ANALYSIS?

In general, whenever there is a need to model and analyze randomness in a system, simulation is the tool of choice. More specifically, situations in which simulation modeling and analysis is used include the following:

1. It is impossible or extremely expensive to observe certain processes in the real world, e.g., next year's cancer statistics, performance of the next space shuttle, and the effect of Internet advertising on a company's sales.
2. Problems in which mathematical model can be formulated but analytic solutions are either impossible (e.g., job shop scheduling problem, high order difference equations) or too complicated (e.g., complex systems like the stock market, and large scale queuing models).
3. It is impossible or extremely expensive to validate the mathematical model describing the system, e.g., due to insufficient data.

Applications of simulation abound in the areas of government, defense, computer and communication systems, manufacturing, transportation (air traffic control), health care, ecology and environment, sociological and behavioral studies, biosciences, epidemiology, services (bank teller scheduling), economics and business analysis.

BENEFITS OF SIMULATION MODELING AND ANALYSIS

According to practitioners, simulation modeling and analysis is one of the most frequently used operations research techniques. When used judiciously, simulation modeling and analysis makes it possible to:

1. Obtain a better understanding of the system by developing a mathematical model of a system of interest, and observing the system's operation in detail over long periods of time.
2. Test hypotheses about the system for feasibility.
3. Compress time to observe certain phenomena over long periods or expand time to observe a complex phenomenon in detail.
4. Study the effects of certain informational, organizational, environmental and policy changes on the operation of a system by altering the system's model; this can be done without disrupting the real system and significantly reduces the risk of experimenting with the real system.
5. Experiment with new or unknown situations about which only weak information is available.
6. Identify the "driving" variables - ones that performance measures are most sensitive to - and the inter-relationships among them.
7. Identify bottlenecks in the flow of entities (material, people, etc.) or information.
8. Use multiple performance metrics for analyzing system configurations.
9. Employ a systems approach to problem solving.
10. Develop well designed and robust systems and reduce system development time.

PITFALLS TO GUARD AGAINST IN SIMULATION

Simulation can be a time consuming and complex exercise, from modeling through output analysis, that necessitates the involvement of resident experts and decision makers in the entire process. Following is a checklist of pitfalls to guard against.

1. Unclear objective.
2. Using simulation when an analytic solution is appropriate.
3. Invalid model.
4. Simulation model too complex or too simple.
5. Erroneous assumptions.
6. Undocumented assumptions. This is extremely important and it is strongly suggested that assumptions made at each stage of the simulation modeling and analysis exercise be documented thoroughly.
7. Using the wrong input probability distribution.
8. Replacing a distribution (stochastic) by its mean (deterministic).
9. Using the wrong performance measure.
10. Bugs in the simulation program.
11. Using standard statistical formulas that assume independence in simulation output analysis.
12. Initial bias in output data.
13. Making one simulation run for a configuration.
14. Poor schedule and budget planning.
15. Poor communication among the personnel involved in the simulation study.